APPLICATION FOR UNITED STATES LETTERS PATENT

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INVENTION:      DATA PROCESSING APPARATUS,
                DATA PROCESSING METHOD,
                PROGRAM, AND
                INK JET PRINTING SYSTEM

S P E C I F I C A T I O N

This application claims priority from Japanese Patent Application No. 2002-247691 filed August 27, 2002, which is incorporated hereinto by reference.

5                  BACKGROUND OF THE INVENTION

                    FIELD OF THE INVENTION

        The present invention relates to a method, an
10   apparatus, a program to process data to be sent to a
     printing apparatus capable of executing a marginless
     printing that leaves no blank margins at edges of a
     print medium, and a printing system including the data
     processing apparatus and the printing apparatus.
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                 DESCRIPTION OF THE RELATED ART

        Among modes in which an ink jet printing
     apparatus prints on a print medium, a so-called
20   marginless printing is known, which forms an image on
     an entire surface of the print medium without leaving
     any blank margins at peripheries of the print medium.
     With this marginless printing, a printing operation is
     performed until there is no blank margin left at at
25   least one of top, bottom, left and right edges of the
     print medium.  To ensure that peripheral parts of the
     print medium are printed reliably, the printing

apparatus ejects ink not only over a print area inside
the edges of the print medium but also over an area
extending a few millimeters outwardly beyond the edges.
Ink that is applied to the outside of the print medium
5    lands on an ink absorbing member on a platen (platen
absorbent) and is absorbed in it.

In this printing apparatus, until the amount of
ink accumulated in the platen absorbent exceeds a
predetermined volume, a problem of contaminated print
10   medium and apparatus scarcely occurs.  But once a total
volume of accumulated waste ink exceeds an absorption
limit of the platen absorbent, the ink oozes out from
this absorbent, staining a back of the print medium or,
in some cases, adhering to an interior of an ink jet
15   printing apparatus.  To deal with this problem, this
kind of ink jet printing apparatus cumulatively adds
up the volume of waste ink applied to the platen
absorbent and, when the sum reaches the absorption
limit of the platen absorbent, displays an error
20   prompting a replacement of the platen absorber.

The management of the waste ink volume and the
error annunciation described above may be carried out
as follows.  (A) The printing apparatus may perform the
steps of (1) analyzing print data received from a host
25   to calculate the waste ink volume applied during the
marginless printing, (2) cumulatively adding a value
representing the calculated waste ink volume to a

value representing a total volume of waste ink accumulated in the platen absorbent up to that point in time (platen waste ink volume) and (3) when the cumulative value exceeds a predetermined value (e.g., absorption limit), issuing an alarm signal, such as an annunciation that "ink may ooze out of a platen absorbent." (B) The host may perform the step of (4) displaying an error based on the alarm signal received from the printing apparatus.

With the method described above, however, since the printing apparatus must perform data processing, such as analyzing the print data sent from the host to calculate the waste ink volume applied during the marginless printing and cumulatively adding the calculated waste ink volume, the processing load of the printing apparatus increases, complicating the control. Another problem is that the load of this additional data processing affects other processing (e.g., indexing the received print data), reducing the processing speed of the apparatus as a whole and therefore the printing operation speed. Further, to store a program for executing the data processing described above requires installing a memory of large capacity (ROM) on the printing apparatus side, and such a large-capacity memory is costly. In addition, for the above data processing to be executed, a high-performance calculation means (CPU) is required. Such

a high-performance calculation means is also costly.
These processing therefore results in a cost increase.

## SUMMARY OF THE INVENTION

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The present invention has been accomplished to
overcome the aforementioned problems experienced with
the conventional techniques and provides a data
processing method, a data processing apparatus and a
10    printing system including the data processing
apparatus and a printing apparatus, which enable a
marginless printing with no ink overflow related
problem, without providing a large-capacity memory or
a high-performance calculation means in the printing
15    apparatus or without reducing a printing speed as
practically as possible.

To achieve the above objective, the present
invention has the following construction.

Viewed from one aspect, the present invention
20    provides a data processing method for processing data
to be supplied to an ink jet printing apparatus,
wherein the ink jet printing apparatus can perform a
marginless printing that forms an image on a print
medium up to the very edges of the print medium by,
25    according to print data, ejecting ink onto an area
inside the edges of the print medium and onto an
overrunning area outside the edges, the data

processing method comprising: a waste ink volume
determining step to determine a value equivalent to a
waste ink volume associated with the marginless
printing; and a data sending step to send to the ink
5    jet printing apparatus data representing the value
equivalent to a waste ink volume determined by the
waste ink volume determining step.

In a second aspect, the present invention
provides a data processing apparatus for supplying
10   data to an ink jet printing apparatus, wherein the ink
jet printing apparatus can perform a marginless
printing that forms an image on a print medium up to
the very edges of the print medium by, according to
print data, ejecting ink onto an area inside the edges
15   of the print medium and onto an overrunning area
outside the edges, the data processing apparatus
comprising: a waste ink volume determining means to
determine a value equivalent to a waste ink volume
associated with the marginless printing; and a data
20   sending means to send to the ink jet printing
apparatus data representing the value equivalent to a
waste ink volume determined by the waste ink volume
determining means.

In a third aspect, the present invention provides
25   a program for controlling an ink jet printing
apparatus, wherein the ink jet printing apparatus can
perform a marginless printing that forms an image on a

print medium up to the very edges of the print medium by, according to print data, ejecting ink over a range from an area inside the edges of the print medium to an overrunning area outside the edges, the program

5   causing a computer to execute a waste ink volume determining step to determine a value equivalent to a waste ink volume associated with the marginless printing; and a data sending step to send to the ink jet printing apparatus data representing the value

10  equivalent to a waste ink volume determined by the waste ink volume determining step.

In a fourth aspect, the present invention provides an ink jet printing system having an ink jet printing apparatus and a host for supplying print data

15  to the ink jet printing apparatus, wherein the ink jet printing apparatus can perform a marginless printing that forms an image on a print medium up to the very edges of the print medium by, according to print data, ejecting ink over a range from an area inside the

20  edges of the print medium to an overrunning area outside the edges, (A) the host comprising: a waste ink volume determining means for determining a value equivalent to a waste ink volume associated with the marginless printing; and a data sending means for

25  sending to the ink jet printing apparatus data representing the value equivalent to a waste ink volume determined by the waste ink volume determining

means; (B) the ink jet printing apparatus comprising:
an ink receiving member for receiving waste ink
ejected onto the overrunning area outside the edges of
the print medium during the marginless printing; and
5    an accumulated value memory means for cumulatively
adding up data representing the values equivalent to
waste ink volumes sent from the host and storing an
accumulated value equivalent to waste ink volumes
ejected onto the ink receiving member during the
10   marginless printing.

    With this invention of the above construction,
complex data processing such as determining a value
equivalent to a waste ink volume is performed by the
host, so that the ink jet printing apparatus needs
15   only to perform very simple processing such as adding
up or storing data processed by the host (data
representing a waste ink volume). This eliminates the
need for a high-performance calculation/storing means
and a large-capacity memory, and enables the system to
20   be constructed at a reduced cost. This arrangement
also enables a high-speed printing even during a
marginless printing.

    Further, since, with this invention, the
processing to determine a value equivalent to a waste
25   ink volume associate with each marginless printing is
performed by the host and the value equivalent to a
waste ink volume determined by the host is sent to the

ink jet printing apparatus which then stores the received value, the processing load on the ink jet printing apparatus can be reduced significantly. Further, this configuration obviates the need for

5   installing a large-capacity memory and a high-performance calculation means and thus can reduce the cost.  Further, since the host executes the waste ink volume determining processing while at the same time performing image processing, the ink jet printing

10  apparatus can omit the processing of reanalyzing print data, simplifying the control system of the printing apparatus as a whole.

The above and other objects, effects, features and advantages of the present invention will become

15  more apparent from the following description of embodiments thereof taken in conjunction with the accompanying drawings.


BRIEF DESCRIPTION OF THE DRAWINGS

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Fig. 1 is a perspective view showing an outline configuration of an ink jet printing apparatus applied to one embodiment of the present invention;

Fig. 2 is a schematic diagram showing an area

25  outside a print medium to which ink is applied during a marginless printing in one embodiment of the invention;

Fig. 3 is an explanatory diagram conceptually showing a sequence of processing performed by a printer driver on a host in one embodiment of the invention;

5      Fig. 4 is a flow chart showing a control operation performed by the host to count ink dots ejected outside the print medium in one embodiment of the invention;

Fig. 5 is a block diagram schematically showing a 10   control system of an ink jet printing apparatus in one embodiment of the invention;

Fig. 6 is a flow chart showing a control operation to set a platen waste ink volume in the ink jet printing apparatus in one embodiment of the 15   invention; and

Fig. 7 is a flow chart showing a control operation executed according to an accumulated volume of platen waste ink in one embodiment of the invention.

20      DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Now, one embodiment of the present invention will be described by referring to the accompanying drawings.

Fig. 1 is a perspective view showing an outline 25   construction of an ink jet printing apparatus that can apply the present invention. In the figure, a print medium P inserted into a paper feed port 100a of the

printing apparatus 100 is fed in a direction of arrow
Y by a feed roller 106 to a printing area where it is
printed by a head cartridge 104.  In the printing area
there is a flat platelike platen 107 on which the

5    print medium P is supported in a horizontal, planar
state.  The platen 107 has a platen absorbent (ink
receiving member), which receives and absorbs ink
applied outside the print medium P.  The platen
absorbent of this embodiment is made so that if waste

10    ink ejected onto the platen absorbent is less than its
maximum ink absorption volume (absorption limit), the
waste ink will not adhere to the back of the print
medium P as it slides over the platen.  The platen
absorbent has a width in excess of a maximum width of

15    the print medium P as measured in the main scan
direction, wide enough to tolerate insertion errors
and transport errors of the print medium P.

        A carriage 101 is axially movable along two guide
shafts 102, 103 and driven by a carriage motor not

20    shown to reciprocally scan in the main scan direction
(indicated by arrows X1, X2).  After each main scan by
the carriage 101, the print medium P is fed a
predetermined distance (equivalent to a print width of
a print head 104) in a subscan direction (indicated by

25    arrow Y) for the next main scan operation.  These main
scan and subscan operations are repeated until one
page printing is completed.

The head cartridge 104 mounted on the carriage 101 has a print head with an array of ink ejection nozzles arranged at a predetermined density and an ink tank to supply ink to the print head. A face of the print head formed with nozzle openings opposes the print medium P transported onto the platen 107. Denoted 108 is an operation unit having switches and indicators, with switches used to turn on or off power of the ink jet printing apparatus 100 and set a variety of printing modes and with the indicators displaying a state of the ink jet printing apparatus 100 in the event of errors.

Fig. 2 schematically shows an area E1 overrunning the print medium P where ink is also applied. As shown in the figure, the ink jet printing apparatus 100 ejects ink dots (waste ink dots) not only inside but also outside the top and bottom edges and left and right edges of the print medium P during the marginless printing. In this embodiment, the volume of waste ink applied to the overrunning area E1 (hereafter referred to as a platen waste ink volume) is determined by a printer driver described later.

Fig. 3 conceptually illustrates a procedure of operation performed by a printer driver used in a host 200 connected to the ink jet printing apparatus of Fig. 1.

In a normal printing, when the user specifies

printing, the host 200 performs separation processing
(202) to separate image data 201 into print data of
four colors (cyan (C), magenta (M), yellow (Y), black
(K)) (in the case of color print data) or black (K)

5    print data (in the case of monochromatic print data).
Next, rasterize processing (203) is executed to
separate print data of each color into 1-raster data.
Then, the rasterized data is sent to an output module
300 where it is subjected to vertical-horizontal

10   conversion and data compression (301). The vertical-
horizontal conversion means processing to convert a
data arrangement from raster data (horizontally
arranged data) into column data (vertically arranged
data).

15       When raster data for one scan is accumulated in
the output module 300, a printing apparatus operation
command is attached to the raster data which is then
transferred to a sending buffer 204. The sending
buffer 204, after a predetermined volume of data is

20   accumulated, sends it to the ink jet printing
apparatus 100.

         When the user specifies a marginless printing,
the printer driver in the host 200 checks if there is
any print data that causes ink to be ejected onto the

25   overrunning area E1 outside the print medium P. If
such print data exists, a waste ink volume
determination means 302 in the output module 300

counts the number of ink dots for each color that are
ejected outside the print medium P. After the printing
operation for one page is finished, the dot count
value for one page is sent from the output module 300
5    to the sending buffer (sending means) 204, from which
it is further transmitted to the ink jet printing
apparatus 100.

Now, the processing of counting the number of ink
dots to be ejected outside the print medium, as
10   performed by the output module 300 when the marginless
printing is specified, will be explained by referring
to the flow chart of Fig. 4.

First, at the head of the print data of one page,
a dot counter for counting the number of ink dots to
15   be ejected outside the print medium P is initialized
(cleared to zero) (step S41). Next, raster data is
retrieved (step S42) and a check is made to see if the
data retrieved is the one for ink dots to be ejected
outside the print medium (step S43). If it is decided
20   that the retrieved raster data is outside the print
medium P, the number of dot data is counted and added
to a cumulative count value (step S44).

After this, it is checked whether the count
operation described above has been done for one page
25   of print data. If it is decided that the count
operation is finished for one page (step S45), the
data for that page representing the count value of ink

dots to be ejected outside the print medium P (waste ink dot number) is transmitted to the ink jet printing apparatus (step S46). If there is a next page to be printed (step S47), the processing is repeated

5    beginning with step S41.

Now, an outline configuration of a main portion of the control system of the ink jet printing apparatus 100 as applied to this embodiment of the invention will be explained by referring to a block

10   diagram of Fig. 5. The control system of the ink jet printing apparatus 100 receives from the host 200 character and image data to be printed and temporarily stores it in a receiving buffer 401. Data representing an operation state of the printing apparatus 100 that

15   was output from a CPU 402 is also transferred through the receiving buffer 401 to the host 200.

The data from the host 200 accumulated in the receiving buffer 401 is processed under the control of the CPU 402 to produce data that can be printed by the

20   print head as it performs the main scan, and the processed data is stored in a random access memory (RAM) 403. The data in the RAM 403 is transferred by a print head control unit to a print head 408 which, according to the received data, drives an ejection

25   energy generation means such as electrothermal transducers in the head to eject ink droplets, thus forming characters and images. A mechanism unit 406

controls the operations of carriage motor and line feed motor not shown. A display unit 407 comprises display panels, such as LEDs and liquid crystal display elements driven by commands from the CPU 402,

5    and a control unit for controlling them.

The host 200, as described above, sends not only the print data for causing ink dots to be ejected onto the print medium but also the count value of ink dots to be ejected outside the print medium (waste ink dot

10    number). The data representing the waste ink dot number is stored in the receiving buffer 401. When this waste ink dot number data is received from the host 200, the CPU 402 retrieves from a programmable nonvolatile memory (accumulated value memory means)

15    405 such as EEPROM an accumulated number of ink dots ejected onto the overrunning area E1 outside the print medium P, adds up the accumulated value and the dot count number stored in the receiving buffer 401, and stores the latest accumulated value of the platen

20    waste ink volume in the EEPROM 405.

A control operation performed by the ink jet printing apparatus when it receives data representing the waste ink dot number from the host 200 will be explained by referring to a flow chart of Fig. 6.

25    First, when the receiving buffer 401 receives data representing the waste ink dot number (step S61), a check is made to see if the value is not zero (step

S62). Next, if the value is determined to be not zero, the platen waste ink volume to be ejected onto the platen absorbent is determined based on the waste ink dot number (step S63). Then, the accumulated platen

5 waste ink volume up to the previous marginless printing operation is read from the EEPROM 405 (step S64), and the platen waste ink volume to be ejected by the current marginless printing operation is added to the accumulated platen waste ink volume (step S65).

10 Then, the newly obtained accumulated platen waste ink volume is stored in (written into) the EEPROM 405 (step S66). While the flow chart of Fig. 6 manages the waste ink volume by using the waste ink volume itself, it may of course be managed by using the number of ink

15 dot number. In that case, the waste ink volume does not have to be calculated from the data representing the waste ink dot number, and the dot number information is stored in the EEPROM 405.

Fig. 7 is a flow chart showing a control

20 operation executed by step S66 of Fig. 6 according to the "accumulated platen waste ink volume" stored in the EEPROM 405.

Each time step S66 of Fig. 6 stores the new accumulated platen waste ink volume in the EEPROM 405,

25 the CPU 402 checks whether the stored accumulated platen waste ink volume has reached (or exceeded) a predetermined value (step S71, S72). Here, the

predetermined value is a maximum ink absorption volume
(absorption limit) of the platen absorbent or a
slightly smaller value. When the accumulated platen
waste ink volume is found to have reached (or
5  exceeded) the predetermined value, an indication
element (such as LED) of the display unit 407 is
turned on, indicating that the waste ink has reached
(or exceeded) the maximum ink absorption volume of the
platen absorbent or is about to reach it. At the same
10  time, warning data is sent to the host 200 (S74). Upon
receiving this warning data, the host 200 displays an
error dialog on a screen, alerting the user to the
fact that the platen absorbent is full of waste ink or
nearly full. In this error state, it may be an
15  effective step to disable the operation of the ink jet
printing apparatus.

The check on the accumulated platen waste ink
volume may be performed when the power of the ink jet
printing apparatus is turned on or after a printed
20  medium is discharged.

With the above embodiment, in the process of
marginless printing, complex processing such as
extracting data of platen waste ink dots from print
data and determining the number of the waste ink dots
25  is carried out by the host 200 and the ink jet
printing apparatus 100 need only sum up the platen
waste ink dot numbers sent from the host 200. This

simplifies the control executed on the part of the ink
jet printing apparatus 100 to a large extent and
obviates the need for a large-capacity memory (e.g.,
ROM) and a high-performance calculation device (e.g.,

5    CPU), resulting in a cost reduction.  This arrangement
also reduces the processing time taken by the ink jet
printing apparatus, preventing a possible reduction in
the printing speed of the ink jet printing apparatus.

Further, in the above embodiment, since a warning

10   is issued to the user when the ink volume absorbed in
the platen absorbent reaches a predetermined value, it
is possible to prevent a print medium from being
stained on its back as it passes over the platen
absorbent that no longer can absorb ink or to prevent

15   an interior of the ink jet printing apparatus from
being contaminated by ink from the platen absorbent.

Further, in the above embodiment, in determining
on the part of the host the waste ink volume applied
during the marginless printing, since the number of

20   ink dots ejected onto the overrunning area outside a
print medium is counted, it is possible to obtain
highly precise information on the waste ink volume in
units of dot.

While in the above embodiment the information on

25   the waste ink volume is obtained by the dot counting
and then transmitted to the printing apparatus, the
present invention is not limited to this configuration.

For example, a value representing a predetermined waste ink volume that matches a print medium size may be selected and sent to the printing apparatus.

That is, the processing of counting dots ejected onto the overrunning area is not performed but a particular value corresponding to the print medium size is determined to be a "value equivalent to the waste ink volume". Since the dot counting is not executed, the precise number of ink dots to be ejected onto the overrunning area outside the print medium is not known and therefore this configuration is not as good as the above embodiment in terms of accurately managing the waste ink volume. It has, however, an advantage of simplified processing because the dot counting is not performed. In this configuration, different values are used as the waste ink volume for different sizes of print media, while the same value is used for print media of the same size without regard to a print duty.

As can be seen from the above, it is important for the host to obtain a value equivalent to the waste ink volume applied during the marginless printing. The method of obtaining this value is not limited to the dot counting.

In the above embodiment, although whether or not the accumulated waste ink volume has reached a predetermined value is checked on the ink jet printing

apparatus side, this check can be done on the host
side. This can alleviate the burden on the ink jet
printing apparatus. It is noted, however, that in this
case too, at least an accumulated value memory means

5    (e.g., ROM) to store a latest accumulated value of the
waste ink volume is required, and that when the power
of the ink jet printing apparatus is turned on, the
accumulated value read from the accumulated value
memory means needs to be transmitted to the host. The

10   host then adds up the accumulated value sent from the
ink jet printing apparatus and the number of waste ink
dots extracted from the print data and sends the sum
as a latest accumulated value to the ink jet printing
apparatus where it is stored in (written into) the

15   accumulated value memory means.

Further, ink jet printing apparatus commonly
perform a preliminary ink ejection operation and a
recovery operation by suction to discharge bubbles and
viscous ink from a print head. Waste ink ejected or

20   sucked out from the print head during this recovery
operation is accommodated in an ink absorbent. In the
above embodiment, a situation is contemplated in which
the waste ink absorbent to absorb ink discharged
during the recovery operation is separately provided

25   in addition to the platen absorbent (waste ink
receiver). Therefore, a warning is issued based on
only the waste ink volume applied during the

marginless printing. In some ink jet printing apparatus, however, the waste ink absorbent for the recovery operation and the platen absorbent are formed integral or connected together. In that case, the ink

5  absorbing state of the waste ink absorbent needs to be detected by also considering the waste ink volume from the recovery operation.

The present invention has been described in detail with respect to preferred embodiments, and it

10  will now be apparent from the foregoing to those skilled in the art that changes and modifications may be made without departing from the invention in its broader aspects, and it is the intention, therefore, in the appended claims to cover all such changes and

15  modifications as fall within the true spirit of the invention.